

Atrial Arrhythmias in Astronauts

Summary of a NASA Summit

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Disclosure Information

82nd Annual Scientific Meeting

We have no financial relationships to disclose.

We will not discuss off-label use and/or investigational use of medications in this presentation .



Objectives

Review recommendations of an expert panel on the implications of atrial arrhythmias for space flight

- Epidemiology
- Screening
- Standards and selection
- Atrial Fibrillation Manifesting Preflight
- Atrial Fibrillation in Flight
- Prevention of Atrial Fibrillation
- Future Research



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Questions of Interest

◆ Epidemiology

- Are Atrial Arrhythmias More Prevalent in the Astronaut Population?
- What are Potential Risk Factors that may Predispose Astronauts to Atrial Arrhythmias both terrestrially and during flight?



Background & Problem Definition

- ◆ Eleven cases of atrial arrhythmias among active NASA astronauts since 1959
- ◆ Atrial fibrillation (seven crewmembers), atrial flutter (one crewmember), or SVT (three crewmembers)
- ◆ Mostly paroxysmal and asymptomatic
- ◆ Five of these crewmembers, slated for long-duration space flight, underwent radiofrequency ablation



The Atrial Arrhythmia Summit

- ◆ Held January 22, 2010 in Houston, Texas
- ◆ Objectives: To solicit expert opinion on screening, diagnosis, and treatment options, identify gaps in knowledge, and propose relevant research initiatives
- ◆ Summit panel : Six cardiologists, including nationally and internationally renowned leaders in cardiac electrophysiology, exercise physiology, and space flight cardiovascular physiology



Summit Panel Members

Dr. J.D. Polk – Chairman

Chief of Space Medicine,
NASA-JSC, Houston, TX

- ◆ **Dr. Andrea Natale**

Texas Cardiac Arrhythmia
Institute, Austin, TX

- ◆ **Dr. Mohamed H. Hamdan**

The University of Utah

- ◆ **Dr. J. David Burkhardt**

Texas Cardiac Arrhythmia
Institute, Austin, TX

- ◆ **Dr. Benjamin D. Levine**

The Univ. of Texas Southwestern
Medical Center at Dallas

- ◆ **Dr. Rodney Horton**

Texas Cardiac Arrhythmia
Institute, Austin, TX

- ◆ **Dr. Richard L. Page**

The Univ. of Wisconsin School of
Medicine & Public Health



The Atrial Arrhythmia Summit

- ◆ **Summit participants:**
 - Flight surgeons
 - Consulting cardiologists
 - Representatives from the astronaut office
 - NASA's research community
 - JSC management and NASA HQ
 - National Space Biomedical Research Institute (NSBRI)
 - NASA Lifetime Surveillance of Astronaut Health (LSAH)
 - United States Air Force (USAF)
 - NASA's international partners
- ◆ **Structured agenda** - Background information, case presentations, panel discussion of directed questions



Epidemiology

Are Atrial Arrhythmias More Prevalent in the Astronaut Population?

- ◆ Prevalence among active NASA astronauts (~ 5%) similar to prevalence in general population (~6%)
- ◆ Younger age at presentation for astronauts (early to mid-40s) compared with the general population (age >60)
 - Closer screening of the astronaut cohort
 - Most discovered incidentally (occupational testing)
 - High parasympathetic tone
 - AFib at younger ages in endurance-trained athletes
 - 200 minutes/wk of intense aerobic exercise increases risk of AFib
 - Statistical chance



What are Potential Risk Factors that may Predispose Astronauts to Atrial Arrhythmias Terrestrially?

- **Gender** – Higher prevalence seen among men
- **Hypertension** – 25% of lone atrial fibrillation cases have undiagnosed hypertension. Recommendation: More aggressive blood pressure screening in all identified arrhythmia cases
- **Endurance training** – Through a variety of mechanisms, including high parasympathetic tone, and perhaps increased left atrial size
- **Triggering events** – Young patients with paroxysmal AFib tend to develop the arrhythmia as a triggered event rather than an underlying substrate disorder
 - Caffeine
 - Sleep apnea
 - Medications



Potential Space Flight-Related Risk factors that may play a role in precipitating lone atrial fibrillation:

- ◆ Microgravity-related fluid shifts and atrial stretch
 - Heart enlarges transiently (equivalent to semi-recumbent terrestrial posture)
 - ADUM Study: No significant changes in the diastolic or systolic dimensions of any cardiac chamber pre-, in- , and postflight
- ◆ Space flight-induced sympathetic activation
 - Sympathetic activation is mild in space
 - Lower than the activation seen with an upright posture on Earth



Potential Space Flight-Related Risk factors that may play a role in precipitating lone atrial fibrillation:

◆ Role of a high sodium diet

- In-flight dietary intake of sodium between 5-10 grams/ day.
- No known direct causal link between high sodium intake and atrial arrhythmias independent of hypertension
- Certain individuals may be salt sensitive → Increase in circulating blood volume → Increase in atrial stretch
- Panel Recommendations:
 - Preflight testing of crewmembers with a 2-week space flight diet, and measurement of atrial volume and filling pressures.
 - Lowering the dietary salt intake to <5 grams/ day

◆ Chronic radiation exposure

No evidence that any variable of the space flight environment increases the likelihood of developing atrial arrhythmias during space flight.



Epidemiology - Summary

Conclusions

- ◆ Prevalence of atrial arrhythmias among astronauts is not excessive compared with the general population
- ◆ Younger age at presentation similar to endurance athletes
- ◆ Combination of frequent screening, higher parasympathetic tone due to exercise, statistical chance
- ◆ There are potential terrestrial risk factors such as gender, hypertension, endurance training and triggering events
- ◆ No evidence that any variable of the space flight environment increases the likelihood of developing atrial arrhythmias during space flight.



Epidemiology - Summary

Recommendations

- ◆ Pursue more aggressive blood pressure screening in all cases of lone atrial fibrillation, using ambulatory blood pressure monitors
- ◆ Conduct preflight testing of crewmembers to evaluate for salt sensitivity (a 2-week diet of space flight foods followed by measurement of atrial volume and filling pressures)
- ◆ Lower dietary salt intake to <5 grams/day



Summit Outcome

- ◆ The Atrial Arrhythmia Summit brought together nationally and internationally recognized experts in an effort to elucidate the mechanisms, risk factors, and management of atrial arrhythmias in the unique occupational cohort of the NASA astronaut corps.
- ◆ The summit demonstrated the value of collaboration among NASA, the NASA supporting contractors, industry, and academia to promote astronaut health and support human endeavors in space.
- ◆ The summit generated valuable discussion and recommendations that were captured in a summary report.
- ◆ A manuscript for broader publication is in work.



Thank You

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